

Claims

1. Method for the removal of asphaltene-paraffin-wax precipitates and prevention of formation thereof on surfaces in contact with crude oil, comprising

5 a) adding tensides, materials for increasing viscosity, and microorganisms capable of breaking down crude oil components or derivatives and producing at least one type of tenside, to the surface, optionally together with additives required for the reproduction of said microorganisms;

10 b) providing an appropriate temperature for the microorganisms after the addition of the materials in step a);

c) allowing the microorganisms to reproduce and act for a predetermined period of time on the surface;

d) checking the results of the treatment; and

15 e) optionally repeating steps (a) to (d) at least once more, preferably at least three more times.

2. The method according to claim 1, wherein in step d) the results of the treatment are checked by confirming the presence of a film on the surface in contact with the crude oil which provides for the living conditions of the said microorganisms and contains the said microorganisms, and optionally steps a) to d) are repeated by changing the parameters,
20 preferably by changing the amount of the tenside or material capable increasing viscosity, or by varying the reproduction time of microorganisms.

3. The method according to claim 1 or 2, wherein the said precipitates are removed from or prevented in the inner surfaces of tubings of oil-wells, flow lines thereof, or in oil pipelines.

25 4. The method according to claims 1 to 3, wherein the said microorganisms and additives are added to the surface at the same time, in the form of an aqueous suspension.

5. The method according claim 4, wherein the suspension of microorganisms contains 10^6 to 10^{12} CFU/liter, preferably 10^7 to 10^{11} CFU/liter, more preferably 10^8 to 10^9 CFU/liter.

30 6. The method according to claim 4 or 5, wherein the volume of the suspension is 100 to 1000 liter/100 m pipe-length, preferably 300 to 800 liter/100 m pipe-length, more preferably 500 to 600 liter/100 m pipe-length.

7. The method according to claim 6, wherein the microorganisms are allowed to reproduce and act for 1 to 15 days, preferably for 6 to 8 days, while the pipes are kept closed.

8. The method according to claims 3 to 7, performed in a production oil-well, and the temperature in the well is determined by the geological conditions.

9. The method according to claims 3 to 8, wherein the results of the treatment are checked by pilot test and by mechanical cleaning test and/or by evaluating the physico-chemical properties, preferably the decrease of viscosity of an oil sample and/or evaluating the drop-size of the asphaltene-paraffin-wax precipitates in an oil-sample by microscopy.

10. The method according to claims 1 to 9, wherein the surfactant is selected from the group consisting of polyoxyethylene ethers and esters, and mixtures thereof, preferably Tween 80.

11. The method according to claims 1 to 10, wherein the material capable increasing viscosity is xanthan.

12. The method according to claims 1 to 11, wherein the asphaltene-paraffin-wax precipitates are removed from the surface in advance by mechanical means.

13. Use of a microorganism capable of breaking down crude oil components or derivatives and producing at least one type of tenside for the removal and prevention of asphaltene-paraffin-wax precipitates by way of forming a film carrying bacteria on surfaces in contact with crude oil.

14. The use according to claim 13 wherein the microorganism is a strain belonging to the *Bacillus subtilis* species, the *Bacillus cereus* species, the *Pseudomonas* genus or the *Xanthomonas* genus, and preferably facultative anaerobic.

15. The use according to claim 13 or 14 wherein the microorganism is selected from the group consisting strains NCAIM (P) B 1304, NCAIM (P) B 1305, NCAIM (P) B 1306, NCAIM (P) B 1307 and NCAIM (P) B 1308 deposited on April 17, 2002 at NCAIM, or any strain derived therefrom, and preferably is a strain that is genetically modified, more preferably modified by the insertion of a DNA fragment with a known sequence as a marker.

16. Kit for the removal or prevention of asphaltene-paraffin-wax precipitates on surfaces in contact with crude oil in pipelines, comprising a microorganism useful in the method of claim 1, further comprising instructions to carry out the method of any of claims 1 to 12.

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17. The kit according to claim 16 comprising one or more of the microorganisms defined in any of claims 13 to 15 and additives necessary for the reproduction thereof.

18. The kit according to claim 16 or 17 further comprising a surfactant and/or a material for increasing viscosity.